Landscape Irrigation Simplified[1]

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Problem

Over-irrigation of landscapes is common where lush, green landscapes are maintained by irrigation. Estimates of the amount of water used for landscape irrigation typically range from 50 to 70 percent of the water used for urban purposes. In the state of Utah, nearly 2/3 of residential water use is to maintain landscapes.[1] Preliminary results of numerous water audits conducted by Utah State University Extension in several metropolitan areas of Utah suggest that the typical landscape manager (professional or homeowner) applies about 80 inches of water each growing season.[2] This is over twice as much as is needed. Nearly 1/3 of the residential water supply is wasted on over-irrigation of landscapes.[3] Anecdotal information suggests that this is relatively typical in many areas.

Consequences of over-irrigation can have far-reaching effects. Existing urban water supplies are being depleted sooner than expected. Existing distribution system capacity is or will be over-taxed during the summer irrigation season resulting in possible system failure. As a result, new water supplies and/or increased system capacity will be expensive to obtain. Over-irrigation can also contribute to groundwater and surface water contamination. Prolonged runoff from over-irrigation can weaken the foundation materials supporting concrete and asphalt pavement resulting in expensive repairs. Further, many plant problems can be linked to improper irrigation.

Experience shows the major factors that, individually or in combination, result in over-irrigating landscapes include:

- Irrigations that occur more frequently than required by the landscape,
- Irrigations that run off or soak past the depth of the roots,
- Irrigation systems that are poorly designed, maintained, and inefficient with sprinklers improperly placed, out of adjustment, or in need of repair.

Informal surveys of homeowners and landscape managers participating in the Bureau of Reclamation's landscape irrigation workshops suggest that only about 15 percent of those in attendance know how much water is being applied by their irrigation systems. Many homeowners think all sprinklers apply the same amount of water. Most know how long the system runs but not how much water is applied. Further, the lack of understanding the concept of uniform application results in the homeowner increasing

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[1]Paper originally prepared for publication in the 2001 Irrigation Association Technical Conference Proceedings.

run times rather than properly addressing the causes of dry spots in the landscape. By watering to the needs of the dry spots, the rest of the landscape is over watered.

Need

In evaluating the problems and causes of over-irrigation, three requirements have been identified for achieving efficient landscape irrigation. These requirements are:

1. Water must be applied evenly to the landscape.
2. Individual irrigation events should apply the proper amount of water in a manner that eliminates runoff.
3. Individual irrigation events should be scheduled to meet actual plant water needs.

Unless all three requirements are satisfied to the greatest level practical, inefficient irrigations will continue. Contemporary efforts to promote more efficient landscape irrigation have usually only focused on one or two of the requirements. Further, much of the advice provided has missed its intended audience. As mentioned above, only about 15 percent of the homeowners and landscape managers know how much water their irrigation systems are applying. For the other 85 percent, recommendations like "water deeper less frequently" and "apply 1 inch of water every 4 days" have little or no meaning. Thus, a different approach is needed to promote more efficient landscape irrigation.

The US Bureau of Reclamation (Reclamation), an agency of the Department of the Interior that supplies water to farmers and communities throughout the west, is committed to making sure scarce water resources are used as efficiently as possible. The Upper Colorado Region of the Bureau of Reclamation recognized the need for more tools and techniques to improve landscape irrigation efficiency in the major urban areas served by its projects. Reclamation identified three basic needs:

1. A simple means to determine the irrigation system performance.
2. A simple, non-technical process for irrigating correctly that can be understood by the majority of the homeowners who have been missed in previous campaigns.
3. A more technical approach to proper irrigation that may be required by a limited number of homeowners, the typical landscape manager, and other irrigation professionals. This would be the group for whom the Certified Landscape Irrigation Audit is too complex or too expensive for normal use.

Solution

Reclamation has developed a simple means for determining system performance; a non-technical process for irrigating home landscapes; and an intermediate approach to fill the gap between the homeowner's process and Certified Landscape Irrigation

Audits. These processes are described briefly here but more detailed discussions can be found on the Upper Colorado Region's website at http://uc.usbr.gov/progact/waterconsv/wtrconhp.html.

Simple Performance Evaluation: The typical homeowner or landscape manager needs a means to assess the performance of the irrigation system. Past options included using containers like soup cans or the measuring cups used by certified landscape irrigation auditors. Soup cans proved to be rather unreliable and cumbersome to use and the mathematics associated with the water audit cups can be overwhelming to individuals with limited math skills.

Reclamation developed a new performance evaluation cup to fill the need for a simple means of determining irrigation system performance. The performance evaluation cup is a self-standing container that is calibrated directly in inches or centimeters of water applied. It provides about the same accuracy as the water audit cups but eliminates the computations. The cups are currently available through local Utah State University Extension offices or may be ordered directly from the manufacturer. In addition, Reclamation can provide non-exclusive licenses to others desiring to manufacture the cups.

Homeowner's Process for Efficient Irrigation: Unless a process is simple and non-technical, it will not be adopted by the typical homeowner. The homeowner's process relies on observation. There is practically no arithmetic involved. The homeowner starts the process by setting out at least four containers in the area of the yard to be evaluated. These containers can be any straight sided container like a soup can, performance evaluation cups, or water audit cups. The irrigation system is run for a short period of time – long enough to get a measurable amount of water in the containers. The homeowner then compares the amount of water in the containers. If the containers all have about the same amount of water, the system is performing satisfactorily. If one of the containers has considerably more or less water than the others, the system is not applying the water evenly. The homeowner is given suggestions for repairing or adjusting the system. Repairs or adjustments are made and the test is repeated to assure that the irrigation system is applying water uniformly.

The homeowner then marks either a 1/2-inch or 5/8-inch depth on the containers, depending upon historic evapotranspiration data. The homeowner turns on the water and observes how long it takes to fill the containers to the marks. The homeowner now knows how long the system should be run each irrigation to apply either 1/2-inch or 5/8-inch of water. To prevent runoff from sloped ground or from soils that absorb water slowly, the time required to fill the containers to the marks is divided by three so the water can be applied in three, shorter applications. For example, in one test it took 15 minutes to fill the containers to the marks. Dividing 15 minutes by 3 equals 5 minutes. The irrigation system would then be run for three 5-minute periods separated by 1-hour

soak periods. This strategy works for all soil types.

Plants use less water in the spring and fall than in the summer. Similarly, they will need to be irrigated less frequently in the spring and fall than in the summer. Applying the amount of water as described above, the landscape should be irrigated every 3-days in the spring, every 2-days (every other day) in the summer, and back to every 3-days in the fall. The summer period is about May 1 through August 31 but may be shorter or longer depending upon local climate. This irrigation schedule is derived from 30-year evapotranspiration data for a composite of about 70 sites located throughout the state of Utah[4].

The homeowner is told how to adapt the above process to either a permanent irrigation system or a hand-moved hose and sprinkler. Using the homeowner's process generally cuts landscape irrigation use in half.

Technical Approach to Efficient Landscape Irrigation: The homeowner's process described above is based upon some very simple assumptions. It assumes that the homeowner through observation can obtain reasonable uniformity and can determine the appropriate irrigation run time based upon an application of about 1/2-inch of water each irrigation. The irrigation application is cycled to accommodate fine, clay soils which are the limiting soil types. And finally, the irrigations are scheduled with a seasonal irrigation schedule. These basic assumptions may not produce the desired or required precision in many instances but a complete Certified Landscape Irrigation Audit is not necessary or feasible. The technical approach fills the gap.

In the technical approach, irrigation system performance characteristics are determined through a performance evaluation. The use of performance evaluation cups is discussed here but other containers could be used with the appropriate adaptation. In some respects, the performance evaluation or test is similar to a Certified Landscape Irrigation Audit but the requirements for numbers and placement of containers is not as rigid. Performance evaluations can be conducted with a minimum of four containers. More containers would be required if greater precision is desired or large areas are involved. The evaluation is run for 6 to 12 minutes, depending upon sprinkler output. Instructions tell how to use the container readings to compute the application rate and distribution uniformity (DU).

A DU of 0.7 or better indicates satisfactory performance of the irrigation system. A DU of less than 0.7 suggests that the irrigation system needs repairs or adjustments before it can irrigate efficiently. The location of containers with either a high or low reading provides some guidance as to where to find irrigation system problems. Suggestions are provided for identifying irrigation system problems and making repairs or adjustments. The performance test should then be repeated to ensure that the repairs and adjustments have produced adequate irrigation system improvement.

The homeowner's process is based upon a 1/2-inch application each irrigation. While this is adequate, plant specialists now frequently recommend applying about 1-inch each application. Aside from different amounts to apply, the soil type can alter the irrigation strategy. The technical approach provides more flexibility to customize the irrigation application for a specific application rate, amount to be applied, and local soil type. Tables are provided that show the number of run cycles and cycle run times for a wide combination of application rates, amounts to apply, and soil types. This information provides the basis for setting automatic controllers or for determining how often to move the hose and sprinkler.

The homeowner's process provides seasonal irrigation schedules which roughly approximate actual plant water needs. Irrigation schedules developed for the technical approach have been refined for local areas based upon 30-year average turf evapotranspiration requirements. They more accurately match irrigation events to actual plant water needs. Instead of having irrigation intervals defined for the three seasons, these schedules contain about 7 intervals. There are usually 3 separate intervals each for the spring and fall as well as one for the summer. These refined schedules will usually eliminate a few irrigations during the early spring and late fall resulting in better overall irrigation efficiency. During early spring and late fall, irrigation intervals can be several days longer than the three days included in the seasonal irrigation schedules. There is also an option to use real-time weather station information to establish the interval for irrigations.

Expected Results

The use of either of the above approaches to improve landscape irrigation efficiency can significantly reduce the typical irrigation application of 80-inches per year. An extended growing season was selected to test this outcome. The period from April 1 to October 31 was selected. This period represents an early spring coupled to a late fall, which can happen quite frequently. With both approaches, the first irrigation applying 1/2-inch of water was assumed to occur on April 1. Subsequent irrigations would also apply 1/2-inch of water each irrigation event. Individual irrigation events would occur as indicated by the appropriate irrigation schedules.

Under the homeowner's process, irrigations were assumed to occur every 3rd day during the spring, every 2nd day during the summer and every 3rd day during the fall until the last irrigation which was assumed to occur on or shortly before October 31. A total of 92 irrigation events would occur during this period for a computed total application of 46-inches of water.

Evaluation of the technical approach used the same type of analysis. Instead of using a seasonal irrigation schedule with three separate intervals, this analysis used a schedule typical of a location in central Utah having seven intervals. This irrigation

schedule had irrigation intervals starting in the spring of 5-days, then 3-days, 2-days, 3-days, 4-days, 7-days, and 10-days, respectively. Using this schedule and an application of 1/2-inch of water each irrigation event, a total of 80 irrigation events would be required with a resulting application of 40-inches of water during the growing season.

From the above analyses, the 7-interval irrigation schedule does provide some additional efficiency over the 3-interval seasonal irrigation schedule. It resulted in 12 fewer irrigations and reduced the annual application amount by 6-inches of water. In either case, though, there is significant reduction in annual application amounts from the typical application of 80-inches of water per year. During many years, the actual growing season is shorter than the test period discussed above. The application of water could be even less than shown in the above analyses.

References

[1] Utah Division of Water Resources. "Utah's Water Resources: Planning for the Future," *Utah State Water Plan,* 2001.

[2] Jackson, Prof. Earl K. Utah State University Cooperative Extension Service. Personal Contact, 2000.

[3] Jackson, Prof. Earl K. and Sarah A. Gedge. *Water Audit Summary 2000*. Utah State University Cooperative Extension Service for Salt Lake County. 2001.

[4] Utah Agricultural Experiment Station. *Consumptive Use of Irrigated Crops in Utah, Research Report 145*. Utah State University. Logan, Utah. 1994 & 1998.